

OFFICE OF NAVAL RESEARCH  
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for

CONTRACT: N0014-89-J-1828

T & T Code 3132080

LIQUID CRYSTALLINE POLYMERS

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September 1, 1995

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R&T Number: 3132080

Contract/Grant Number: N00014-89-J-1828

Contract/Grant Title: Liquid Crystalline Polymers

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WWW Homepage:

- a. Number of papers submitted to refereed journals, but not published: 0  
b. Number of papers published in refereed journals (provide complete citations): 74  
c. Number of books or chapters submitted, but not yet published: 0  
d. Number of books or chapters published (provide complete citations): 11  
e. Number of printed technical reports/non-refereed papers (provide complete citations): 0  
f. Number of patents filed: 0  
g. Number of patents granted (for each, provide a complete citation): 0  
h. Number of invited presentations (for each, provide a complete citation): 285  
i. Number of submitted presentations (for each, provide a complete citation): 0  
j. Honors/Awards/Prizes for contract/grant employees (list attached): see attached  
(This might include Scientific Society Awards/Offices, Selection as Editor,  
Promotion, Faculty Award, etc.)  
k. Total number of Full-time equivalent Graduate Students and Post-Doctoral associates  
supported during this period, under this R&T project number: 12  
    Graduate Students: 10  
    Post-Doctoral Associates: 2  
    including the number of,  
        Female Graduate Students: 3  
        Female Post-Doctoral Associates: 0  
    the number of  
        Minority\* Graduate Students: 0  
        Minority\* Post-Doctoral Associates: 1  
    and, the number of  
        Asian Graduate Students: 2  
        Asian Post-Doctoral Associates: 0  
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of performance and a brief statement regarding the relationship of that research to your ONR  
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an under-represented or minority group in science and engineering.

**Office of Naval Research: Liquid Crystal Polymers (N00014-89-J-1828)**  
**b. List of Papers Published in Refereed Journals: 4/1/1989-9/30/1995**

1. C. S. Hsu and V. Percec, Synthesis and Characterization of Liquid Crystalline Polyacrylates and Polymethacrylates Containing Benzyl Ether and Diphenyl Ethane Based Mesogens, J. Polym. Sci. Polym. Chem. Ed., 27, 453 (1989)
2. V. Percec and C. Pugh, Molecular Engineering of Predominantly Hydrocarbon Based Liquid Crystalline Polymers, in Side Chain Liquid Crystalline Polymers, C. B. McArdle Ed., Blackie and Son Ltd., Glasgow and Chapman and Hall, New York, 1989, p.30-105
3. V. Percec and D. Tomazos, Synthesis and Characterization of Liquid Crystalline Polymethacrylates, Polyacrylates and Polysiloxanes Containing 4-Methoxy-4'-Hydroxy- $\alpha$ -Methylstilbene-Based Mesogenic Groups, J. Polym. Sci. Polym. Chem. Ed., 27, 999 (1989)
4. V. Percec and D. Tomazos, Transformation of a Monotropic Mesophase into an Enantiotropic Mesophase by Copolymerization of the Parent Polymers' Monomer Pair Containing Constitutional Isomeric Mesogenic Side Groups, Macromolecules, 22, 1512 (1989)
5. V. Percec and D. Tomazos, Synthesis and Characterization of Liquid Crystalline Polymethacrylates, Polyacrylates and Polysiloxanes Containing 4-Hydroxy-4'-methoxy- $\alpha$ -methylstilbene Based Mesogenic Groups, Macromolecules, 22, 2062 (1989)
6. V. Percec, D. Tomazos and C. Pugh, Influence of Molecular Weight on the Thermotropic Mesophases of Poly{6-[4-(4-methoxy- $\beta$ -methylstyryl)phenoxy]hexyl methacrylate}, Macromolecules, 22, 3259 (1989)
7. V. Percec and D. Tomazos, Suppression of Side Chain Crystallization and Transformation of Monotropic Mesophases into Enantiotropic Mesophases by Copolymerization of the Parent Polymers' Monomer Pairs Containing Constitutional Isomeric Mesogenic Side Groups, Polymer, 30, 2124 (1989)
8. V. Percec, D. Tomazos and R. A. Willingham, The Influence of the Polymer Backbone Flexibility on the Phase Transitions of Side Chain Liquid Crystal Polymers Containing 6-[4-(4-Methoxy- $\beta$ -methylstyryl)phenoxy]hexyl Side Groups, Polym. Bull., 22, 199 (1989)
9. C. J. Hsieh, C. S. Hsu, G. H. Hsiue and V. Percec, Synthesis and Characterization of Side Chain Liquid Crystalline Polysiloxanes Containing Oligooxyethylene Spacers and Benzyl Ether Based Mesogenic Groups, J. Polym. Sci. Polym. Chem. Ed., 28, 425 (1990)
10. V. Percec and D. Tomazos, Can the Rigidity of a Side-Chain Liquid Crystalline Polymer Backbone Influence the Mechanism of Distortion of Its Random-Coil Conformation?, Polymer, 31, 1658 (1990)

11. V. Percec, D. Tomazos and A. E. Feiring, Semifluorinated Polymers: 1. Synthesis and Characterization of Side Chain Liquid Crystalline Polymers Containing Semifluorinated Oligooxyethylene Based Flexible Spacers, Polymer, **32**, 1897 (1991).
12. V. Percec, B. Hahn, M. Ebert and J. H. Wendorff, Liquid Crystalline Polymers Containing Heterocycloalkanedyl Groups as Mesogens. 8. Morphological Evidence for Microphase Separation in Poly(methylsiloxane-co-dimethyl-siloxane)s Containing 2-[4-(2(S)-Methyl-1-butoxy)phenyl]-5-(11-Undecanyl)-1,3,2-Dioxaborinane Side Groups, Macromolecules, **23**, 2092 (1990)
13. V. Percec and C. S. Hsu, Synthesis and Mesomorphic Behavior of Poly(methylsiloxane)s and Poly(methylsiloxane-co-dimethylsiloxane)s Containing Oligooxyethylene Spacers and Mesogenic Side Groups, Polym. Bull., **23**, 463 (1990)
14. V. Percec, M. Lee and H. Jonsson, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. II. Living Cationic Polymerization of 11-[(4-Cyano-4'-biphenyl)oxy]undecanyl Vinyl Ether and the Mesomorphic Behavior of the Resulting Polymers, J. Polym. Sci. Polym. Chem. Ed., **29**, 327 (1991)
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16. H. Jonsson, V. Percec and A. Hult, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 4. Synthesis and Cationic Polymerization of Some Mesogenic Vinyl Ethers Containing Various Functional Groups, Polym. Bull., **25**, 115 (1991)
17. V. Percec and J. Heck, Liquid Crystalline Polymers Containing Mesogenic Units Based on Half-Disc and Rod-Like Moieties. 1. Synthesis and Characterization of 4-(11-Undecan-1-yloxy)-4'-[3,4,5-tri(p-n-Dodecan-1-yloxybenzyloxy)benzoate]Biphenyl Side Groups, J. Polym. Sci. Polym. Chem. Ed., **29**, 591 (1991)
18. V. Percec and J. Heck, Liquid Crystalline Polymers Containing Mesogenic Units Based on Half-Disc and Rod-Like Moieties. 2. Synthesis and Characterization of Poly{2-[3,4,5-tri[p-(n-dodecan-1-yloxy)benzyloxy]benzoate]-7-[p-(11-undecan-1-yloxy)benzoate]naphthalene} methyl siloxane}, Polym. Bull., **24**, 255 (1990)
19. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 5. Synthesis and Mesomorphic Behaviour of Poly{2-[(4-cyano-4'-biphenyl)oxy]ethyl Vinyl Ether-co-8-[(4-cyano-4'-biphenyl)oxy]octyl vinyl ether}, Polymer, **32**, 2862 (1991)
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23. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. VIII. Influence of Molecular Weight on the Phase Behavior of Poly{ $\omega$ -[(4-cyano-4'-biphenyl)oxy]alkyl Vinyl Ether}s with Ethyl, Propyl and Butyl Alkyl Groups, J. Macromol. Sci.- Chem., **A28**, 651 (1991)
24. V. Percec, M. Lee and C. Ackerman, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization: 9. Living Cationic Polymerization of 5-[(4-cyano-4'-biphenyl)oxy]pentyl Vinyl Ether and 7-[(4-cyano-4'-biphenyl)oxy]heptyl Vinyl Ether, and the Mesomorphic Behaviour of the Resulting Polymers, Polymer, **33**, 703 (1992)
25. V. Percec, C. G. Cho, C. Pugh and D. Tomazos, Synthesis and Characterization of Branched Liquid Crystalline Polyethers Containing Cyclotetraerarylene-Based Disklike Mesogens, Macromolecules, **25**, 1164 (1992)
26. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 10. Influence of Molecular Weight on the Phase Transitions of Poly{ $\omega$ -[(4-cyano-4'-biphenyl)oxy]alkyl vinyl ether}s with Nonyl and Decanyl Alkyl Groups, Macromolecules, **24**, 2780 (1991)
27. V. Percec, A. S. Gomez and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. XI. Synthesis and Characterization of Poly{11-[(4-cyano-4'-*trans*- $\alpha$ -Cyanostilbene)oxy]undecanyl Vinyl Ether}, J. Polym. Sci. Polym. Chem. Ed., **29**, 1615 (1991)
28. V. Percec and J. Heck, Liquid Crystalline Polymers Containing Mesogenic Units Based on Half-Disc and Rod-Like Moieties. 4. Side Chain Liquid Crystalline Polymethylsiloxanes Containing Hemiphasmidic Mesogens Based on 4-[3,4,5-Tri-(alkan-1-yloxy)benzoate Biphenyl Groups, Polym. Bull., **25**, 431 (1991)
29. V. Percec, C. S. Wang and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 12. Synthesis and Living Cationic Polymerization of 4-[S(-)-2-methyl-1-butoxy]-4'-( $\omega$ -oxyalkyl-1-vinyl ether)- $\alpha$ -methylstilbene with Octyl and Hexyl Alkyl Groups, Polym. Bull., **26**, 15 (1991)
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31. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 14. Synthesis and Characterization of Binary Copolymers of  $\omega$ -[4-

- Cyano-4'-biphenyl)oxy]alkyl Vinyl Ethers Containing Undecanyl and Hexyl, Pentyl and Propyl, and Undecanyl and Propyl Pairs of Alkyl Groups, Macromolecules, **24**, 4963 (1991)
32. V. Percec, J. Heck and G. Ungar, Liquid Crystalline Polymers Containing Mesogenic Units Based on Half-Disc and Rodlike Moieties. 5. Side Chain Liquid Crystalline Poly(methylsiloxane)s Containing Hemiphasmidic Mesogens Based on 4-[[3,4,5-Tri(alkan-1-yloxy)benzoyl]oxy]-4'-[[p-(propan-1-yloxy)benzoyl]oxy]biphenyl Groups, Macromolecules, **24**, 4957 (1991)
  33. J. Hopken, M. Moller, M. Lee and V. Percec, Synthesis of Poly(vinyl ether)s with Perfluoroalkyl Pendant Groups, Makromol. Chem., **193**, 275 (1992)
  34. V. Percec and M. Lee, Molecular Engineering of Liquid-crystalline Polymers by Living Polymerization. 15. Molecular Design of Re-entrant Nematic Mesophases in Binary Copolymers of 4-( $\omega$ -Vinylalkoxy)biphenyl-4-yl Cyanides, J. Mater. Chem., **1**, 1007 (1991)
  35. U. W. Gedde, H. Jonsson, A. Hult and V. Percec, Phase Transitions in Narrow-Molar-Mass Samples of Side-Chain Liquid-Crystalline Polymers: Molar-Mass Dependence, Polymer, **33**, 4532 (1992)
  36. V. Percec, Q. Zheng and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 16. Tailor-Made  $SC^*$  Mesophase in Copolymers of (S)-(-)-2-Methylbutyl-4'-( $\omega$ -Vinylalkoxy)biphenyl-4-carboxylate with Undecanyl and Octyl Alkyl Groups, J. Mater. Chem., **1**, 1015 (1991)
  37. H. Jonsson, V. Percec, U. W. Gedde and A. Hult, Cationic Bulk Polymerization of Vinyl Ethers in the Liquid Crystalline Phase, Makromol. Chem. Macromol. Symp., **54/55**, 83 (1992)
  38. V. Percec, M. Lee, P. L. Rinaldi and V. E. Litman, Molecular Engineering of Liquid Crystalline Polymers by Living Polymerization. XVII. Characterization of Poly{10-[(4-Cyano-4'-Biphenyl)oxy]decanyl Vinyl Ether}s by 1-D and 2-D  $^1H$ -NMR Spectroscopy, J. Polym. Sci. Polym. Chem. Ed., **30**, 1213 (1992)
  39. V. Percec, H. Jonsson and D. Tomazos, "Reactions and Interactions in Liquid Crystalline Media", in Polymerization in Organized Media, C. M. Paleos Ed., Gordon and Breach, New York, 1992, p. 1-104
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  41. V. Percec and D. Tomazos, "Molecular Engineering of Liquid Crystalline Polymers" in Comprehensive Polymer Science, First Supplement, G. Allen Ed., Pergamon Press, Oxford, 1992, p. 299-383



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43. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 20. Synthesis and Characterization of Binary Copolymers of [11-(4'-Cyanobiphenyl-4-yloxy)undecanyloxy]ethylene with *n*-Butyl Vinyl Ether and of 2-[(4'-Cyanobiphenyl-4-yl)oxy]ethyl Vinyl Ether with (*n*-Butoxy)ethylene, J. Mater. Chem., **2**, 617 (1992)
44. V. Percec, M. Lee and D. Tomazos, Molecular Engineering of Liquid Crystalline Polymers by Living Cationic Polymerization. 21. Synthesis and Characterization of Poly{3-[(4-Cyano-4'-Biphenyl)oxy]propyl Vinyl Ether} Macromonomers, Polym. Bull., **28**, 9 (1992)
45. V. Percec, M. Lee and Q. Zheng, Molecular Engineering of Liquid Crystalline Polymers by Living Polymerization. XXII. Synthesis and Characterization of Binary Copolymers of 11-[4-Cyano-4'-biphenyl]oxy]undecanyl Vinyl Ether with (2*S*, 3*S*)-(+)-2-Chloro-3-methylpentyl-4'-(8-vinyloxyoctyloxy)biphenyl-4-carboxylate and of (2*S*, 3*S*)-(+)-2-Chloro-3-methylpentyl-4'-(8-vinyloxyoctyloxy)biphenyl-4-carboxylate with 3-[4-Cyano-4'-biphenyl]oxy]propyl Vinyl Ether, Liq. Cryst., **12**, 715 (1992)
46. V. Tsukruk, J. H. Wendorff, V. Percec and M. Lee, Structural Rearrangements During Mesomorphic Phase Transitions in Poly{10-[(4-Cyano-4'-biphenyl)oxy]decanyl Vinyl Ether}, Polymer, **34**, 481 (1993)
47. V. Percec and M. Lee, Molecular Engineering of Liquid Crystal Polymers by Living Polymerization. 23. Synthesis and Characterization of AB Block Copolymers Based on  $\omega$ -[(4-Cyano-4'-biphenyl)oxy]alkyl Vinyl Ether, 1*H*, 1*H*, 2*H*, 2*H*-Perfluorodecyl Vinyl Ether, and 2-(4-Biphenyloxy)ethyl Vinyl Ether with 1*H*, 1*H*, 2*H*, 2*H*-Perfluorodecyl Vinyl Ether, J. Macromol. Sci. Chem., **A29**, 723 (1992)
48. V. Percec and D. Tomazos, Molecular Engineering of Side Chain Liquid Crystalline Polymers, in Contemporary Topics in Polymer Science Vol. 7: "Advances in New Materials," J. C. Salamone and J. Riffle Eds., Plenum Press, New York, 1992, p. 247-268
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50. V. Percec and D. Tomazos, Molecular Engineering of Side-Chain Liquid-Crystalline Polymers by Living Cationic Polymerization, Adv. Mater., **4**, 548 (1992)
51. V. Percec and Q. Zheng, Molecular Engineering of Liquid-Crystalline Polymers by Living Polymerization. 24. Synthesis of Poly(vinyl ether)s Exhibiting an S<sub>C</sub>\* Phase by Living Cationic Polymerization of (2*S*, 3*S*)-(+)-2-Chloro-3-methylpentyl 4'-(6-vinyloxyhexyloxy)biphenyl-4-carboxylate and its Copolymerization with (2*S*, 3*S*)-(+)-2-Chloro-3-methylpentyl 4'-(8-vinyloxyoctyloxy)biphenyl-4-ylcarboxylate, J. Mater. Chem., **2**, 1041 (1992)

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53. H. A. Schneider, V. Percec and Q. Zheng, Effects of Monomer Structure and Copolymer Composition on the Glass Transition Temperature of Binary Liquid Crystalline Copoly(vinyl ether)s, Polymer, **34**, 2180 (1993)
54. V. Percec and Q. Zheng, Liquid Crystalline Networks via Living Cationic Polymerization of 11-[(4-Cyano-4'-biphenyl)oxy]undecanyl Vinyl Ether with 11-Vinyloxyundecanyloxy Methacrylate, Polym. Bull., **29**, 485 (1992)
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57. H. Fadel, V. Percec, Q. Zheng, R. C. Advincula and R. S. Duran, Liquid Crystalline Poly(vinyl ether)s with Bulk Smectic  $C^*$  Phases at the Air/Water Interface, Macromolecules, **26**, 1650 (1993)
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60. V. Percec, J. Heck, D. Tomazos and G. Ungar, The Influence of Complexation of Sodium and Lithium Triflate on the Self-Assembly of Tubular-Supramolecular Architectures Displaying a Columnar Mesophase Based on Taper-Shaped Monoesters of Oligooxyethylene Oxide with 3,4,5-Tris[*p*-(*n*-dodecan-1-yloxy)benzyloxy]benzoic Acid and of their Polymethacrylates, J. Chem. Soc. Perkin Trans. 2., 2381 (1993)
61. D. Tomazos, R. Out, J. Heck, G. Johansson, V. Percec and M. Moeller, Isomorphism Within the Hexagonal Columnar Mesophase of Molecular and Macromolecular Self- and Co-Assembled Columns Containing Tapered Groups, Liq. Cryst., **16**, 509 (1994)
62. V. Percec, J. Heck, G. Johansson, D. Tomazos and G. Ungar, Towards Tobacco Mosaic Virus-Like Self-Assembled Supramolecular Architectures, Macromol. Symp., **77**, 237 (1994)
63. V. Percec, J. Heck, G. Johansson, D. Tomazos, M. Kawasumi and G. Ungar, Molecular Recognition Directed Self-Assembly of Supramolecular Polymers, J. Macromol. Sci., Pure Appl. Chem., **A31**, 1031 (1994)



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65. V. Percec and H. Oda, Heterochiral Interactions in Molecular and Macromolecular Pairs of Liquid Crystals of (*R*)- and (*S*)-2-Fluoro-4-methylpentyl 4'-[(8-(Vinylloxy)octyl)oxy]biphenyl-4-carboxylate Enantiomers, Macromolecules, **27**, 5821 (1994)
66. V. Percec, J. Heck, G. Johansson, D. Tomazos, M. Kawasumi, P. Chu and G. Ungar, Molecular Recognition Directed Self-Assembly of Supramolecular Liquid Crystals, Mol. Cryst. Liq. Cryst., **254**, 137-196 (1994)
67. V. Percec and Q. Zheng, Synthesis and Mesomorphic Behavior of Poly[(2*S*, 3*S*)-(+)-2-chloro-3-methylpentyl 4'-( $\omega$ -vinylloxyalkoxy)biphenyl-4-carboxylate]s with Ethyl and Propyl Alkyl Groups, Polym. Bull., **32**, 249 (1994)
68. V. Percec, J. Heck, G. Johansson, D. Tomazos, M. Kawasumi, P. Chu and G. Ungar, Molecular Recognition Directed Self-Assembly of Supramolecular Architectures, J. Macromol. Sci., Pure Appl. Chem., **A31**, 1719 (1994)
69. M. Trollsas, A. Hult and V. Percec, Synthesis and Characterization of Novel Sulphonyl-Containing Liquid-Crystalline Side Chain Poly(vinyl ether)s, Macromol. Chem. Phys., **196**, 1821(1995)
70. V. Percec and H. Oda, Heterochiral Molecular Recognition in Molecular and Macromolecular Pairs of Liquid Crystals of 4'-(11-vinylundecanyloxy)biphenyl (2*R*, 3*S*)- and (2*S*, 3*S*)-2-Fluoro-3-methylpentanoate Diastereomers, J. Macromol. Sci., Pure Appl. Chem., **A32**, 1531(1995)
71. V. Percec and H. Oda, Molecular Engineering of Liquid Crystalline Polymers by "Living" Polymerization. 30. Synthesis and "Living" Cationic Polymerization of (2*R*, 3*S*)-2-Fluoro-3-methylpentyl 4'-(8-vinylloxyoctyloxy)biphenyl-4-carboxylate and Its Copolymerization with (2*R*,3*S*)-2-Fluoro-3-methylpentyl 4'-(11-vinylloxyundecanyloxy)biphenyl-4-carboxylate, J. Mater. Chem., **5**, 1115(1995)
72. V. Percec and H. Oda, Molecular Engineering of Liquid Crystalline Polymers by "Living" Polymerization. 31. Synthesis and "Living" Cationic Polymerization of (2*R*,3*S*)-2-Fluoro-3-methylpentyl 3-Fluoro-4'-( $\omega$ -vinylloxy-alkoxy)biphenyl-4-carboxylate with Undecanyl and Octyl Alkyl Groups, J. Mater. Chem., **5**, 1125(1995)
73. V. Percec and H. Oda, Molecular Engineering of Liquid Crystalline Polymers by "Living" Polymerization. 32. Synthesis and "Living" Cationic Polymerization of 3-Fluoro-4'-( $\omega$ -vinylloxyalkoxy)-4-biphenyl (2*R*,3*S*)-2-Fluoro-3-methylpentanoate with Undecanyl and Octyl Alkyl Groups, J. Polym. Sci., Part A: Polym. Chem., **33**, 2359(1995)
74. V. Percec, From Molecular to Macromolecular Liquid Crystals, in Handbook of Liquid Crystal Research, Peter J. Collings and J. S. Patel Eds., Oxford University Press, Oxford,1997, pg. 259-346

**d. Number of books or chapter published: 11** (see no. 2, 39, 41, 48, 50, 52, 62, 63, 66, 68, 74 from list b )

**h. Invited Presentations: 285**

197. "Molecular Engineering of Liquid Crystal Copolymers" by **V. Percec**, Plenary Perkin Speaker, Royal Society of Chemistry Meeting, University of Hull, Hull, United Kingdom, April 4-7, 1989.
198. "Conformational and Constitutional Isomerism in Liquid Crystal Polymers," by **V. Percec**, Plenary Lecture, British Society of Liquid Crystals, University of Sheffield, Sheffield, United Kingdom, April 10-12, 1989.
199. "X-ray Studies of Mesomorphism in Polymers with a Semiflexible Mesogen" by **J. L. Feijoo, G. Ungar, A. Keller, R. Yourd, and V. Percec**, Poster, British Society of Liquid Crystals, University of Sheffield, Sheffield, United Kingdom, April 10-12, 1989.
200. "Non-Equilibrium States of Order in the Isotropic and Nematic States of Main Chain Polymers" by **J. L. Feijoo, G. Ungar, A. Keller and V. Percec**, Poster, British Society of Liquid Crystals, University of Sheffield, Sheffield, United Kingdom, April 10-12, 1989.
201. "LCP Based on Conformational Isomerism" by **V. Percec**, BP Research, London, United Kingdom, April 13, 1989.
202. "Side Chain LCPs" by **V. Percec**, GEC Research, London, United Kingdom, April 14, 1989.
203. "LCP Based on Conformational Isomerism" by **V. Percec**, Goodyear Tire and Rubber Co., Akron, OH, April 18, 1989.
204. "LC Polymers" by **V. Percec**, Pennsylvania State University, University Park, PA, April 27, 1989.
205. "Molecular Engineering of LCP" by **V. Percec**, University of Akron, Akron, OH, May 3, 1989.
206. "Side Chain LCPs" by **V. Percec**, Amoco Research and Development, Bound Brook, NJ, May 10, 1989.
207. "Aromatic Polyethers" by **V. Percec**, Amoco Research and Development, Bound Brook, NJ, May 10, 1989.
208. "LCPs New Synthetic Trends" by **V. Percec**, Case Western Reserve University, Cleveland, OH, May 11, 1989.
209. "LC Polymers" by **V. Percec**, National Starch Co., Bridgewater, NJ, May 24, 1989.
210. "Synthesis of LCPs Does Not Require Rigid Rod-Like Mesogenic Units" by **V. Percec**, Plenary Lecture, ACS Meeting, Cleveland, OH, May 31-June 2, 1989.

211. "Molecular Engineering of Side Chain LCPs" by **V. Percec**, Army Technology Laboratory, Watertown, MA, June 23, 1989.
212. "Highly Decoupled Side Chain LCPs" by **V. Percec**, Conference on LCPs, University of Massachusetts, Amherst, MA, June 24, 1989.
213. "LC Copolymers" by **V. Percec**, Invited Main Lecture, Gordon Research Conference on Polymers, Colby-Sawyer College, New London, NH, June 25-29, 1989.
214. "Virtual LCPs" by **V. Percec**, BASF Ludwigshaffen, Germany, July 18, 1989.
215. "Virtual LCPs" by **V. Percec**, BP Research, Grangemouth, Scotland, July 26, 1989.
216. "Virtual LCPs" by **V. Percec**, Bayer, Leverkusen, Germany, August 3, 1989.
217. "News in the Synthesis of LCPs" by **V. Percec**, Mobay, Pittsburgh, August 16, 1989.
218. "LC Polyethers and Copolyethers Based on Conformational Isomerism" by **V. Percec**, R. Yourd and Y. Tsuda, ACS Meeting, Miami Beach, FL, September 11-15, 1989. *Polymer Preprints*, 30/2, 487 (1989).
219. "LCPs Containing Constitutional Isomeric Mesogenic Side Groups" by **V. Percec** and D. Tomazos, ACS Meeting, Miami Beach, FL, September 11-15, 1989. *Polymer Preprints*, 30/2, 507 (1989).
220. "Main Chain and Side Chain LCPs Containing Crown Ethers" by **V. Percec** and R. Rodenhouse, ACS Meeting, Miami Beach, FL, September 11-15, 1989. *Polymer Preprints*, 30/2, 444 (1989).
221. "Side Chain LCPs Containing Mesogenic Units Based on Half Disk and Rod-Like Moieties" by **V. Percec** and J. Heck, ACS Meeting, Miami Beach, FL, September 11-15, 1989. *Polymer Preprints*, 30/2, 450 (1989).
222. "Influence of Copolymer Composition of a Ternary Copolyether Based on a Single Mesogenic Unit and Three Dissimilar Flexible Spacers on Its Mesomorphic Phase Transitions" by **V. Percec** and Y. Tsuda, ACS Meeting, Miami Beach, FL, September 11-15, 1989. *Polymer Preprints*, 30/2, 452 (1989).
223. "What are LCPs Providing Us With?" by **V. Percec**, Mobay, Pittsburgh, PA, October 12, 1989.
224. "Side Chain LCPs" by **V. Percec**, University of Rochester, Rochester, NY, October 25, 1989.
225. "Molecular Composites" by **V. Percec**, BP Research, Cleveland, OH, November 30, 1989.
226. "Synthesis of LCP Does Not Require Rigid Rod-Like Mesogens" by **V. Percec**, Hoechst-Celanese, NJ, December 4, 1989.

227. "Macromonomers and Telechelics of PPO" by **V. Percec**, BASF, Ludwigshafen, Germany, February 26, 1990.
228. "Phase Transfer Cross-Coupling of Aryl Halides with Alkylborates Catalyzed by  $\text{PdCl}_2(\text{dppf})_2$  and Base" by **V. Percec** and **E. Cramer**, Freiburg Makromolekulares Kolloquium, Freiburg, Germany, March 1-3, 1990. *Abstracts*, 9 (1990).
229. "New Developments in Polymer Synthesis" by **V. Percec**, PPG, Pittsburgh, PA, March 20, 1990.
230. "Living Polymerization of Mesogenic Vinyl Ethers" by **V. Percec**, Invited Lecture, British Society of Liquid Crystals Annual Conference, Bristol, United Kingdom, April 9-11, 1990.
231. "Smectic and Crystalline Phases in Main Chain Copolymers with a Semiflexible Mesogen" by **J. L. Feijoo**, **G. Ungar**, **V. Percec** and **R. Yourd**, Poster, British Society of Liquid Crystals Annual Conference, Bristol, United Kingdom, April 9-11, 1990.
232. "Structure of Liquid Crystal Phases of a Crown Ether Side Chain Polymer" by **G. Ungar**, and **V. Percec**, Poster, British Society of Liquid Crystals Annual Conference, Bristol, United Kingdom, April 9-11, 1990.
233. "Smectic and Crystalline Phases in Main Chain Copolymers with a Semiflexible Mesogen" by **V. Percec**, Poster, British Society of Liquid Crystals Annual Conference, Bristol, United Kingdom, April 9-11, 1990.
234. "New Polymerization Reactions" by **V. Percec**, BP, London, United Kingdom, April 12, 1990.
235. "Phase Transfer  $\text{Pd}(\text{O})$  Catalyzed Polymerization by Cross-Coupling of Alkyl-Boron Compounds and Aromatic Halides Catalyzed by  $\text{PdCl}_2(\text{dppf})$  and Bases" by **E. Cramer** and **V. Percec**, ACS Meeting, Boston, MA April 22-26, 1990. *Polymer Preprints*, 31/1, 516 (1990).
236. "Synthesis and Determination of the Virtual Mesophases of Polyethers Based on 1-(4-Hydroxyphenyl)-2-(2-Methyl-4-Hydroxyphenyl)ethane with  $\alpha,\beta$ -Dibromoalkanes Containing from Four to Twenty Methylene Units" by **V. Percec** and **Y. Tsuda**, ACS Meeting, Boston, MA, April 22-26, 1990. *Polymer Preprints*, 31/1, 514 (1990).
237. "LCP Containing Crown Ethers by Living Cationic Cyclopolymerization of 1,2-Bis(2-Ethenyloxy)benzene with Mesogenic Vinyl Ethers" by **R. Rodenhouse** and **V. Percec**, ACS Meeting, Boston, MA, April 22-26, 1990. *Polymer Preprints*, 31/1, 81 (1990).
238. " $\text{Pd}(\text{O})$  Phase Transfer Catalyzed Oligomerization by Cross-Coupling Reactions of Acetylenes with Aryl Halides or Aryl Triflates" by **C. Pugh** and **V. Percec**, ACS Meeting, Boston, MA, April 22-26, 1990. *Polymer Preprints*, 31/1, 512 (1990).

239. "What is PTC Providing Polymer Chemistry With?" by **V. Percec**, Plenary Speaker, International Symposium on Phase Transfer Catalysis, ACS Meeting, Boston, MA, April 22-26, 1990.
240. "Virtual LCPs" by **V. Percec**, Invited Main Lecture, International Symposium Dedicated to O. Vogl, ACS Meeting, Boston, MA, April 22-26, 1990.
241. "Virtual LCP" by **V. Percec**, Rensselaer Polytechnic Institute, Chemistry Department, Troy, NY, April 30, 1990.
242. "Molecular Engineering of LCPs" by **V. Percec**, University of Akron, Akron, OH, May 2, 1990.
243. "New Trends in Polymer Synthesis" by **V. Percec**, Goodyear, Akron, OH, May 3, 1990.
244. "Virtual Liquid Crystal Polymers" by **V. Percec**, Akron Polymer Conference, Akron, OH, May 14-15, 1990.
245. "Crystalline Phases of a Polyether Based on MBPE and Flexible Spacers" by **V. Percec**, Akron Polymer Conference, OH, May 14-15, 1990.
246. "News in Chain Polymerization Reactions" by **V. Percec**, Royal Institute of Technology, Stockholm, Sweden, May 28, 1990.
247. "Structure Reactivity in Ionic Polymerizations" by **V. Percec**, Royal Institute of Technology, Stockholm, Sweden, May 28, 1990.
248. "Molecular Engineering of LCP" by **V. Percec**, Plenary Lecture, Symposium on Functional Organic Materials and Liquid Crystalline Polymers, Royal Institute of Technology, Stockholm, Sweden, May 30, 1990.
249. "News in Step Polymerization Reactions" by **V. Percec**, Royal Institute of Technology, Stockholm, Sweden, May 31, 1990.
250. "PTC in Polymer Chemistry" by **V. Percec**, Royal Institute of Technology, Stockholm, Sweden, June 4-6, 1990.
251. "Virtual Liquid Crystal Polymers" by **V. Percec**, Invited Main Lecture, Scandinavian Meeting on Polymer Science, Helsinki, Finland, June 4-6, 1990.
252. "Synthesis and Living Carbocationic Polymerization of Side Chain Liquid Crystalline Vinyl Ethers" by **H. Jonsson**, U. W. Gedde, P. E. Sundell, **V. Percec** and A. Hult, Scandinavian Meeting on Polymer Science, Helsinki, Finland, June 4-6, 1990.
253. "Liquid Crystalline Polyethers and Copolyethers Based on Conformational Isomerism" by **V. Percec**, Invited Main Lecture, 2nd AIM Conference on Advanced Topics in Polymer Science: Polycondensation and Related Reactions, Gargnano, Italy, June 10-15, 1990. *Abstracts*, 24 (1990).
254. "Polymer Backbone Effects in Side Chain LCPs" by **V. Percec**, Ecole Supérieure de Physique et de Chimie Industrielle de Paris, France, June 19, 1990.

255. "LCP Based on Conformational Isomerism" by **V. Percec**, Invited Main Lecture, Gordon Research Conference on LCP, Colby-Sawyer College, New London, NH, July 2-6, 1990.
256. "Phase Behavior in One Thermotropic Polyether Involving Rod-like Mesogenic Groups Based on Conformational Isomerism" by **V. Percec**, Gordon Research Conference on LCP, Colby-Sawyer College, New London, NH, July 2-6, 1990.
257. "'Polymer Effect' in Side Chain Liquid Crystal Polymers" by **V. Percec**, Invited Main Lecture, The 13th International Conference on Liquid Crystals, University of British Columbia, Vancouver, Canada, July 22-27, 1990. *Abstracts*, I-75 (1990).
258. "Synthesis and Living Carbocationic Polymerization of Side Chain Liquid Crystalline Vinyl Ethers" by **H. Jonsson**, C. G. Cho, U. W. Gedde, A. Hult and **V. Percec**, The 13th International Conference on Liquid Crystals, University of British Columbia, Vancouver, Canada, July 22-27, 1990. *Abstracts*, I-176 (1990).
259. "Refractive Indices of a Methylstilbene Polymer Liquid Crystal" by **N. A. Vaz**, G. W. Smith, G. P. Montgomery, Jr., W. D. Marion, **V. Percec** and M. Lee, The 13th International Liquid Crystal Conference, University of British Columbia, Vancouver, Canada, July 22-27, 1990. *Abstracts*, II-375 (1990).
260. "Dynamic Light Scattering from a Side-Chain Liquid Crystal Polymer Dissolved in a Nematic Solvent" by D.-F. Gu, **A. M. Jamieson**, A. Saeed, G. deLisi, C. Rosenblatt, D. Tomazos and **V. Percec**, The 13th International Liquid Crystal Conference, University of British Columbia, Vancouver, Canada, July 22-27, 1990. *Abstracts*, IV-383 (1990).
261. "New Trends in Polymerization Reactions" by **V. Percec**, Goodyear, Akron, OH, July 31, 1990.
262. "New Trends in Polymer Synthesis" by **V. Percec**, Mobay Corp., Pittsburgh, PA, August 3, 1990.
263. "Aromatic Polymers" by **V. Percec**, Bayer, Krefeld, Germany, August 8, 1990.
264. "Virtual LCPs" by **V. Percec**, Twente University, Enschede, Holland, August 9, 1990.
265. "Mechanism of Aromatic Nucleophilic Substitution" by **V. Percec**, Hoechst, Frankfurt, Germany, August 16, 1990.
266. "Polymer Science in the Last Decade of the 20th Century" by **V. Percec**, Mobay Corp., Pittsburgh, PA, September 5, 1990.
267. "Molecular Engineering of LCPs" by **V. Percec**, Xerox Research Center, Missisauga, Canada, September 21, 1990.
268. "Influence of Constitutional Isomerism of Mesogenic Units Based on Combination of Rigid Rod-like and Flexible Moieties" by **A. D. S. Gomes** and **V. Percec**, Macromolecular Colloquium, Puerto Allegre, Brazil, October 14-18, 1990.
269. "Study of Main Chain LCPs Based on Conformational Isomerism" by **V. Percec**, SPSJ 39th Symposium on Macromolecules, Nagoya, Japan, October 17-19, 1990.



270. "Molecular Engineering of Liquid Crystal Polymers" by **V. Percec**, Invited Main Lecture, US-Japan Seminar on Polymer Synthesis, Tokyo, Japan, October 28-November 2, 1990. *Abstracts*, 67 (1990).
271. "Virtual LCPs" by **V. Percec**, Waseda University, Tokyo, Japan, November 2, 1990.
272. "Molecular Engineering of Side Chain LCPs" by **V. Percec**, NTT, Tokyo, Japan, November 5, 1990.
273. "What Do We Expect From LCPs?" by **V. Percec**, Toyota Central Research Laboratory, Nagoya, Japan, November 6, 1990.
274. "LCPs Based on Conformational Isomerism" by **V. Percec**, Mitsubishi Petrochemical Co., Yokkaichi-city, Japan, November 7, 1990.
275. "Synthesis of LCP Does Not Require Rigid Mesogens" by **V. Percec**, Unitika, Ltd., Kyoto, Japan, November 7, 1990.
276. "Functional LCPs" by **V. Percec**, Tokyo Institute of Technology, Tokyo, Japan, November 9, 1990.
277. "Molecular Engineering of Side Chain LCP" by **V. Percec**, Plenary Lecture, 15th Biennial ACS Polymer Symposium Advances in New Materials, Ft. Lauderdale, FL, November 17-21, 1990.
278. "New Polymers by Aromatic Nucleophilic Displacement" by **V. Percec**, Goodyear, Akron, OH, December 11, 1990.
279. "Molecular Engineering of Side-Chain LCPs by Living Polymerizations" by **V. Percec**, University of Freiburg, Freiburg, Germany, February 20, 1991.
280. "Molecular Engineering of LCPs by Living Polymerization" by **V. Percec**, Chiao Tung University, Hsinchu, Taiwan, March 20, 1991.
281. "Liquid Crystalline Polymers Bond on Conformational Isomerism" by **V. Percec**, Tsing Hua University, Hsinchu, Taiwan, March 20, 1991.
282. "Aromatic Polyethers: New Synthetic Trends" by **V. Percec**, Tsing Hua University, Hsinchu, Taiwan, March 20, 1991.
283. "Virtual Liquid Crystalline Polymers" by **V. Percec**, Tsing Hua University, Hsinchu, Taiwan, March 21, 1991.
284. "Liquid Crystalline Polymers" by **V. Percec**, Tsing Hua University, Hsinchu, Taiwan, March 22, 1991.
285. "Phase Transfer Catalysis in Polymer Chemistry" by **V. Percec**, Cheng Kong University, Tainan, Taiwan, March 22, 1991.
286. "New Thermotropic Columnar Phases in Non-Discotic Polymers" by **V. Percec**, Poster, The British Liquid Crystal Society Annual Conference, The University of Reading, Reading, United Kingdom, March 25-27, 1991.

287. "Time Dependent Effects in the Nematic-Isotropic Transition of Main Chain Mesogenic Polymers" by G. Ungar, J. L. Feijoo, A. Alvarez-Castello, A. Keller and V. Percec, Polymer Physics Conference to mark the retirement of A. Keller, Bristol, UK, April 3-5, 1991.
288. "Living Cationic Polymerization of  $\omega$ -[(4-Cyano-4'-biphenyl)oxy]alkyl Vinyl Ethers" by V. Percec and M. Lee, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 212 (1991).
289. "Liquid Crystalline Polyethers and Octa-n-Alkyloxy Derivatives Containing CTTV Mesogens" by V. Percec, C. G. Cho, C. Pugh and D. Tomazos, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 257 (1991).
290. "Synthesis and Determination of the "Virtual" Mesophases of the Polyethers Based on 1-(4-Hydroxy)-2-(2-Chloro-4-Hydroxy)ethane and Flexible Spacers Containing From Four to Twenty Methylene Units" by V. Percec and M. Zuber, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 259 (1991).
291. "Mesomorphic Polyethers Based on the Semiflexible 1-(4-Hydroxy-4'-Biphenyl)-2-(4-Hydroxyphenyl)butane" by V. Percec and M. Kawasumi, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 261 (1991).
292. "Liquid Crystalline Polyethers Based on Conformational Isomerism. 16. Hexagonal Columnar Phase ( $\Phi_h$ ) in a Non-Discotic Copolyether and the Novel 2-Dimensional to 3-Dimensional  $\Phi_h$ -S<sub>B</sub> Transition" by G. Ungar, J. L. Feijoo, V. Percec and R. Yourd, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 282 (1991).
293. "Side Chain Liquid Crystal Polymers Containing Hemiphasmidic Mesogens" by V. Percec and J. Heck, Symposium on Macromolecular Assemblies, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 263 (1991).
294. "Cationic Bulk Polymerization of Vinyl Ethers in the Liquid Crystalline Phase" by H. Jonsson, V. Percec U. W. Gedde and A. Hult, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 320 (1991).
295. "Pd(0) and Ni(0) Catalyzed Polymerization Reactions" by V. Percec, C. Pugh, E. Cramer and R. Weiss, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 329 (1991).
296. "The S<sub>N</sub>Ar Versus S<sub>RN</sub>1 in the Synthesis of Aromatic Poly(ether ketone)s" by V. Percec, R. S. Clough, P. L. Rinaldi and V. E. Litman, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 353 (1991).

297. "Phase Transfer Catalyzed Anion-Radical Polymerization of 4-Bromo-2,6-Dimethyl-phenol" by V. Percec and J. H. Wang, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 355 (1991).
298. "Polymers Containing Tetramethylantracene and Cyclotetraphenylene Units by Electro-philic Cyclopolymerization Reactions" by V. Percec, C. Pugh, C. G. Cho and J. M. Tingerthal, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 359 (1991).
299. "Synthesis of Aromatic Polyethers by Cation-Radical Polymerization" by V. Percec and J. Wang, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 391 (1991).
300. "Reactivity of  $\omega$ -(Vinylbenzyl Ether) Macromonomer of Poly(2,6-Dimethyl-1,4-Phenylene Oxide)" by V. Percec and J. H. Wang, International Symposium on New Polymerization Reactions and Reaction Mechanisms, ACS Meeting, Atlanta, GA, April 14-19, 1991. *Polymer Preprints*, 32/1, 563 (1991).
301. "Condensation Polymerizations" by V. Percec, Tutorial Lecture for Joint Symposia, New Polymerization Reactions and Reaction Mechanisms and Stereochemistry and Mechanism of Homogeneous Polymerization Reactions, ACS Meeting, Atlanta, GA, April 14-19, 1991.
302. "Liquid Crystalline Polymers by Living Cationic Polymerization" by V. Percec, University of Bayreuth, Bayreuth, Germany, May 16, 1991.
303. "Virtual Liquid Crystalline Polymers" by V. Percec, Max Plank Institute for Polymer Research, Mainz, Germany, July 31, 1991.
304. "Aromatic Poly(ether ketone)s" by V. Percec, Hoechst, Frankfurt, Germany, August 1, 1991.
305. "Molecular Recognition Directed Supramolecular Polymer Architectures" by V. Percec and J. Heck, ACS Meeting, New York, NY, August, 1991. *Polymer Preprints*, 32/3, 698 (1991).
306. "Molecular Engineering of LCPs" by V. Percec, University of Lowell, Lowell, MA, September 12, 1991.
307. "Molecular Engineering of LCPs by Living Polymerization" by V. Percec, Ecole Supérieure de Chimie Industrielle, Paris, France, September 18, 1991.
308. "Molecular Engineering of LCPs" by V. Percec, University of Bordeaux, France, September 26, 1991.
309. "What is Polymer Chemistry Going to Do in the Next Century?" by V. Percec, National Starch Co, Bridgewater, NJ, October 25, 1991.
310. "Supramolecular LCPs" by V. Percec, BP Research, Cleveland, OH, November 22, 1991.

311. "Synthesis of Linear, Branched and Cyclic Liquid Crystalline Polymers" by V. Percec, International IUPAC Symposium on New Polymers, Kyoto, Japan, November 30 - December 1, 1991.
312. "Synthesis of Soluble Polyphenylenes and Aromatic Polyethers by a Combination of Ni(O), Pd(O), and Cation Radical Reactions" by V. Percec, International IUPAC Symposium on New Polymers, Kyoto, Japan, November 30 - December 1, 1991.
313. "A Universal Emulsifier for Polyethylene" by V. Percec, BP Research, Cleveland, OH, December 9, 1991.
314. "Supramolecular LCPs" by V. Percec, ETH, Zürich, Switzerland, January 27, 1992.
315. "Supramolecular LCPs" by V. Percec, University of Stuttgart, Stuttgart, Germany, January 28, 1992.
316. "Supramolecular LCPs" by V. Percec, MPI, Mainz, Germany, January 29, 1992.
317. "Supramolecular LCPs" by V. Percec, BASF, Ludwigshafen, Germany, January 30, 1992.
318. "Supramolecular LCPs" by V. Percec, University of Freiburg, Freiburg, Germany, January 31, 1992.
319. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by V. Percec, DSM, Central Research, Maastricht, Holland, February 25, 1992.
320. "Introduction to Molecular, Macromolecular and Supramolecular LCs" by V. Percec, University of Utrecht, Holland, February 25, 1992.
321. "Molecular Engineering of LCPs by Living Cationic Polymerization" by V. Percec, University of Utrecht, Holland, February 25, 1992.
322. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by V. Percec, University of Utrecht, Holland, February 25, 1992.
323. "Macrocyclic and Dendrimeric LCPs" by V. Percec, University of Utrecht, Holland, February 25, 1992.
324. "Molecular, Macromolecular and Supramolecular LCs with Complex Architecture" by V. Percec, MIT, Cambridge, MA, March 10, 1992.
325. "D-NMR Study of Molecular Order in the Nematic Melt of a Semiflexible Polyether" by V. Percec, Am. Phys. Soc. Meeting, Indianapolis, IN, March 16-20, 1992. *Bull. Am. Phys. Soc.*, 37/1, 369 (1992).
326. "Dielectric Relaxation of a Smectic Side-Chain Liquid Crystal Polymer in Different Orientation States" by V. Percec, Am. Phys. Soc. Meeting, Indianapolis, IN, March 16-20, 1992. *Bull. Am. Phys. Soc.*, 37/1, 419 (1992).

327. "Polymerization Methods: From Molecular to Supramolecular Polymer Chemistry" by **V. Percec**, National Academy of Sciences Meeting, Washington, DC, March 27, 1992.
328. "Towards Tobacco Mosaic Virus-Like Supramolecular Synthetic Polymers" by **V. Percec**, **J. Heck** and **G. Ungar**, Invited Main Lecture, Symposium on Well Defined Polymers, ACS Meeting, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 152 (1992).
329. "Molecular Design of Externally Regulated Self-Assembled Supramolecular Ionic Channels" by **V. Percec** and **J. Heck**, ACS Meeting, Symposium on Well Defined Polymers, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 217 (1992).
330. "Molecular Recognition Directed Phase Transitions of Side Chain Liquid Crystalline Polymers Containing Crown Ethers" by **V. Percec**, **G. Johansson** and **R. Rodenhouse**, Symposium on Well Defined Polymers, ACS Meeting, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 219 (1992).
331. "Synthesis and Characterization of a Thermotropic Liquid Crystalline Dendrimer" by **V. Percec** and **M. Kawasumi**, Symposium on Well Defined Polymers, ACS Meeting, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 221 (1992).
332. "Synthesis and Characterization of Macrocyclic Liquid Crystalline Polyethers" by **V. Percec** and **M. Kawasumi**, Symposium on Well Defined Polymers, ACS Meeting, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 223 (1992).
333. "Synthesis of Soluble Polyarylenes and Polyarylene Ethers by Increased Configurational Entropy of Their Backbone" by **V. Percec**, **J. Wang** and **S. Okita**, Symposium on Well Defined Polymers, ACS Meeting, San Francisco, CA, April 6-10, 1992. *Polymer Preprints*, 33/1, 225 (1992).
334. "Supramolecular Polymers" by **V. Percec**, Plenary Speaker, Symposium on Advances in Polymer Chemistry, Du Pont Country Club, Wilmington, DE, April 24, 1992.
335. "Supramolecular LCPs" by **V. Percec**, Plenary Speaker, 24th Central Regional ACS Meeting, Cincinnati, OH, April 27-29, 1992.
336. "Molecular Engineering of Side Chain LCPs by Living Polymerization" by **V. Percec**, ONR Polymer Program Meeting, Isle of Palms, SC, April 29 - May 1, 1992.
337. "Liquid Crystalline Polymers: Problems and Trends" by **V. Percec**, Phasex Corp., Lawrence, MA, May 21, 1992.
338. "Supramolecular Liquid Crystal Polymers" by **V. Percec**, Invited Main Lecture, 14th IUPAC International Liquid Crystal Conference, Pisa, Italy, June 21-26, 1992. *Abstracts*, 832 (1992).
339. "Preparation of Ordered, Crosslinked and Thermally Stable Liquid Crystalline Poly(Vinyl Ether) Films" by **A. Hult**, **H. Andersson**, **U. W. Gedde** and **V.**

- Percec, 14th IUPAC International Liquid Crystal Conference, Pisa, Italy, June 21-26, 1992. *Abstracts*, 855 (1992).
340. "New Main-Chain and Side Chain Column-Forming Polymers and Oligomers" by **G. Ungar**, V. Percec, J. Heck and S. Nieder, 14th IUPAC International Liquid Crystal Conference, Pisa, Italy, June 21-26, 1992. *Abstracts*, 429 (1992).
  341. "Characterization of liquid Crystalline Non-Linear Optical Model Compounds" by **M. Trollsas**, V. Percec and A. Hult, 14th IUPAC International Liquid Crystal Conference, Pisa, Italy, June 21-26, 1992. *Abstracts*, 853 (1992).
  342. "Supramolecular LCPs" by **V. Percec**, Invited Main Lecture, Gordon Research Conference on Liquid Crystal Polymers, Colby Sawyer College, New London, NH, July 5-10, 1992.
  343. "Towards Molecular Recognition Directed Self-Assembled Molecular Ionic Channels" Gordon Research Conference on Liquid Crystal Polymers, Colby Sawyer College, New London, NH, July 5-10, 1992.
  344. "Self-Regulated Phase Transitions in Side-Chain Liquid Crystalline Polymers Containing Crown Ethers Via Molecular Recognition," Gordon Research Conference on Liquid Crystal Polymers," Colby Sawyer College, New London, NH, July 5-10, 1992.
  345. "Dendrimeric Liquid Crystalline Polymers," Gordon Research Conference on Liquid Crystal Polymers, Colby Sawyer College, New London, NH, July 5-10, 1992.
  346. "Macrocyclic LCPs," Gordon Research Conference on Liquid Crystal Polymers, Colby Sawyer College, New London, NH, July 5-10, 1992.
  347. "Chiral Recognition in Side Chain LCPs," Gordon Research Conference on Liquid Crystal Polymers, Colby Sawyer College, New London, NH, July 5-10, 1992.
  348. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by **V. Percec**, University of Bayreuth, Germany, July 22, 1992.
  349. "Molecular Engineering of Side Chain LCPs by Living Polymerization" by **V. Percec**, Plenary Lecture, International Symposium: on 25th Anniversary of the Institute of Materials Science, National University, Mexico City, Mexico, August 17-21, 1992.
  350. "Supramolecular Liquid Crystalline Polymers" by **V. Percec**, Plenary Lecture, International Symposium on 25th Anniversary of the Institute of Materials Science, National University, Mexico City, Mexico, August 17-21, 1992.
  351. "Molecular Engineering of Liquid Crystalline Polymers" by **V. Percec**, Plenary Lecture, International Symposium: on 25th Anniversary of the Institute of Materials Science, National University, Mexico City, Mexico, August 17-21, 1992.
  352. "Supramolecular LCPs" by **V. Percec**, University of Sheffield, United Kingdom, September 3, 1992.



353. "Supramolecular Liquid Crystal Polymers" by **V. Percec**, Invited Main Lecture, Macromolecules 1992 Third Euro-American Conference: Functional Polymers and Biopolymers, University of Kent, Canterbury, United Kingdom, September 7-11, 1992. *Abstracts*, 25 (1992).
354. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by **V. Percec**, Polytechnic University, Chemistry Department, New York, NY, September 16, 1992.
355. "Supramolecular Polymers" by **V. Percec**, PPG Industries, Pittsburgh, PA, September 18, 1992.
356. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by **V. Percec**, University of Pittsburgh, Chemistry Department, Pittsburgh, PA, October 8, 1992.
357. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by **V. Percec**, Dow Invited Speaker, University of Detroit, Chemistry Department, Detroit, MI, October 15, 1992.
358. "LCPs with Complex Architectures" by **V. Percec**, University of Bordeaux, France, October 26, 1992.
359. "Activated Bisarylhalides in the Synthesis of Poly(etherketone)s" by **V. Percec**, Du Pont, Central Research and Development, Wilmington, DE, November 20, 1992.
360. "Molecular, Macromolecular and Supramolecular LCs with Complex Architecture" by **V. Percec**, University of Mississippi, Hattiesburg, MS, February 3, 1993.
361. "Macromolecular and Supramolecular LCs with Complex Architecture" by **V. Percec**, Virginia Polytechnic Institute and State University, Chemistry Department, Blacksburg, VA, February 10, 1993.
362. "Towards Tobacco Mosaic Virus-Like Self-Assembled Supramolecular Architectures" by **V. Percec**, J. Heck and G. Johansson, Invited Main Lecture, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 116 (1993).
363. "Synthesis and Characterization of Macrocyclic LC Oligopolyethers" by **V. Percec** and **M. Kawasumi**, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 154 (1993).
364. "Synthesis and Characterization of Chiral Linear and Macrocyclic LC Polyethers" by **V. Percec** and **M. Kawasumi**, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 156 (1993).
365. "Synthesis and Characterization of Thermotropic LC Dendrimers" by **V. Percec** and **M. Kawasumi**, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 158 (1993).

366. "Absence of Chiral Recognition in Molecular and Macromolecular Pairs of Liquid Crystals of (2R,3S)- and (2S,3S)-2-Fluoro-3-methylpentyl-4'-(11-vinyloxy undecanyloxy)biphenyl-4-carboxylate Diastereomers" by V. Percec and H. Oda, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 160 (1993).
367. Poster: Design of Molecular Architecture Enables Synthesis of Fully Aromatic Poly(ether ketone)s by Aromatic Nucleophilic Substitution of "Unreactive" Ketone Activated Bis(aryl chloride)s" by V. Percec, R. S. Clough, J. Fanjul and M. Grigoros, International Symposium on Polymers with Complex Architecture and Supramolecular Polymers, ACS, Spring Meeting, Denver, CO, March 28-April 4, 1993. *Polymer Preprint*, 34/1, 162 (1993).
368. "Molecular Engineering of Side Chain LCPs by Living Cationic Polymerization Using Webster's Initiating System" by V. Percec, Invited Main Lecture, ACS, Division of Polymeric Materials, Science and Eng., Denver, CO, March 28-April 4, 1993. *Polym. Mat. Sci.: Eng.*, 68, 60 (1993).
369. "Polymers with Columnar Hexagonal Phases" by V. Percec, British Society of Liquid Crystals, Manchester, United Kingdom, March 28-April 4, 1993.
370. "Ionically and H-Bonded Self-Assembled Liquid Crystals" by V. Percec, poster, The British Liquid Society Annual Conference, The University of Manchester, Manchester, United Kingdom, March 29-31, 1993.
371. "Cyclic Main Chain Oligoether Smectics" by V. Percec, poster, The British Liquid Society Annual Conference, The University of Manchester, Manchester, United Kingdom, March 29-31, 1993.
372. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by V. Percec, Cornell University, Chemistry Department, Ithaca, NY, May 10, 1993.
373. "Molecular Recognition Directed Self-Assembly of Supramolecular Liquid Crystalline Polymers" by V. Percec, Invited Main Speaker, International Workshop on Liquid Crystalline Polymers, Capri, Italy, June 1-4, 1993. *Abstracts*, 19 (1993).
374. "Molecular Engineering of Side Chain Liquid Crystalline Polymers by Living Polymerization" by V. Percec, Invited Main Speaker, European Polymer Federation Workshop: Molecular Engineering of Side-Chain Liquid Crystalline Polymers, Yverdon-les-Bains, Switzerland, June 9-11, 1993. *Abstracts*, 2 (1993).
375. "Synthesis of Novel Liquid Crystalline Side-Chain Polymers Exhibiting and Sc\* Phase" by M. Trollsas, V. Percec and A. Hult, European Polymer Federation Workshop: Molecular Engineering of Side-Chain Liquid Crystalline Polymers, Yverdon-les-Bains, Switzerland, June 9-11, 1993. *Abstracts*, 3 (1993).
376. "Macrocyclic Liquid Crystals" by V. Percec, Max Planck Institute for Polymer Research, Mainz, Germany, July 15, 1993.

377. "Supramolecular LCPs" by **V. Percec**, Cavendish Laboratory, Cambridge University, Cambridge, United Kingdom, July 19, 1993.
378. "Reductive Dehalogenation versus Nucleophilic Substitution in the Synthesis of Aromatic Poly(ether ketone)s and Poly(ether sulfone)s: A Potential Competition Between SET and POLAR Pathways" by **V. Percec** and **R. Clough**, Invited Main Lecture, Symposium in Advanced Polyethers, ACS, Division of Polymer Material Science Engineering, Chicago, IL, August 22-26, 1993. *Polym. Mater. Sci. Eng.*, **69**, 246 (1993).
379. "Molecular Recognition Directed Self-Assembly of Supramolecular Liquid Crystals" by **V. Percec**, Invited Main Lecture, International Symposium on Macromolecular Engineering, Akron, OH, August 27-28, 1993.
380. "Molecular Recognition Directed Self-Assembly of Supramolecular Liquid Crystals" by **V. Percec**, J. Heck, G. Johansson, D. Tomazos, M. Kawasumi, P. Chu and G. Ungar, Invited Main Lecture, International Workshop on Liquid Crystalline Polymers, Seoul, Korea, August 30-September 2, 1993. *Abstracts*, **26** (1993).
381. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Korea Advanced Institute for Science & Technology, Taejon, Korea, September 2, 1993.
382. "Molecular Engineering of Side-Chain Liquid Crystalline Polymers by Living Cationic Polymerization" by **V. Percec**, Korea Advanced Institute for Science & Technology, Taejon, Korea, September 3, 1993.
383. "Synthesis and Liquid Crystallinity of Cyclic Polyethers Containing Mesogenic Units in Their Main Chains" by **V. Percec**, The 19th National Meeting of Liquid Crystals, Tokyo University, Tokyo, Japan, September 20-22, 1993.
384. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Chemistry Department, Carnegie Mellon University, Pittsburgh, PA, October 21, 1993.
385. "Molecular, Macromolecular, and Supramolecular Liquid Crystals" by **V. Percec**, ONR Polymer Program Symposium, Naval Research, Washington, DC, October 25-27, 1993.
386. "Molecular Recognition Directed Self-Assembly of Supramolecular Polymers" by **V. Percec**, 17th Annual Symposium on Current Contributions in Polymer Science and Engineering, University of Michigan, Ann Arbor, MI, October 28-29, 1993.
387. "Supramolecular Polymers" by **V. Percec**, Invited Main Speaker, PolyMex-93, International Symposium on Polymers, Cancun, Mexico, November 1-5, 1993.
388. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, 6th US-Japan Bilateral Seminar on Polymer Synthesis, "Macromolecular Design for Advanced Materials," Santa Rosa, CA, November 6-12, 1993. *Abstracts*, **31** (1993).

389. "Synthesis and Characterization of Noncrystallizable Main Chain Liquid Crystalline Polyethers" by **V. Percec**, The 5th National Meeting of Polymer Processing Engineering, Nagoya, Japan, November 8-9, 1993.
390. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Firestone Lecturer, Frontiers in Chemistry, Case Western Reserve University, Cleveland, OH, November 18, 1993.
391. "New Concepts in Fluoropolymers" by **V. Percec**, E. I. DuPont de Nemours, Experimental Station, Wilmington, DE, December 16, 1993.
392. "Gel-Template Leaching and Other Concepts to Functional Microporous Membranes" by **H. Gankema**, M. Möller, G. Johansson and **V. Percec**, Makromolekulares Kolloquium, Freiburg, Germany, February 24-26, 1994. *Abstracts*, 22 (1994).
393. "Molecular Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, University of Munchen, Munchen, Germany, March 10, 1994.
394. "Towards TMV-Like Supramolecular Polymers" by **V. Percec**, University of Ulm, Ulm, Germany, March 11, 1994.
395. "Macrocyclic Liquid Crystals" by **V. Percec**, University of Freiburg, Freiburg, Germany, March 15, 1994.
396. "Are Macrocyclic LC Supramolecular Rods?" by **V. Percec**, University of Ulm, Ulm, Germany, March 16, 1994.
397. "Supramolecular Rods from Collapsed Macrocyclics" by **V. Percec**, Max Planck Institute for Polymer Research, Mainz, Germany, March 17, 1994.
398. "Main Chain Thermotropic PE Exhibiting Calamitic-Columnar and Calamitic-Nematic Phases" by **V. Percec**, poster, The British Liquid Crystal Society 9th Annual Conference, The University of Hull, Hull, United Kingdom, March 28-30, 1994.
399. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Invited Lecture, Minisymposium on "Molecular Engineering and Supramolecular Chemistry," Division of Organic Chemistry, Danish Chemical Society, Copenhagen, Denmark, May 6, 1994.
400. "Molecular Recognition Directed Self-Assembly of Supramolecular Channel-like and Rod-like Architectures" by **V. Percec**, Invited Lecture, NATO Advanced Research Workshop on "Molecular Engineering for Advanced Materials," Hindsigavl, Denmark, May 7-11, 1994.
401. "Molecular Recognition Directed Self-Assembly of Tubular Liquid Crystalline and Crystalline Supramolecular Architectures Derived from Crown Ethers Containing Tapered Groups" by **V. Percec** and **G. Johansson**, Poster, NATO Advanced Research Workshop on "Molecular Engineering for Advanced Materials," Hindsigavl, Denmark, May 7-11, 1994.

402. "Self-Organizing Polymer Liquid Crystals" by **V. Percec**, Plenary Lecture, Symposium on "Molecular Organization in Thin Films," Centre for Molecular Materials, University of Sheffield, Sheffield, UK, May 16, 1994.
403. "The Supramolecular Tubular Structures of a Poly(methacrylate) with Tapered Side Groups Formed in its Aligned Hexagonal Phases" by **Y. K. Kwon**, J. Blackwell, S. Chvalun, A.-I. Schneider, V. Percec and J. A. Heck, ACS, Division of Polymer Chemistry, Graduate Research Polymer Conference, Penn State University, University Park, PA, June 12-15, 1994.
404. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Invited Lecture, Gordon Research Conference on Polymers, Wolfeboro, July 3-8, 1994.
405. "Reductive Dehalogenation Versus Nucleophilic Substitution in the Synthesis of Aromatic Poly(ether Ketone)s and Poly(ether Sulfone)s: A Potential Competition Between SET and Polar Pathways" by **V. Percec** and R. S. Clough, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 135 (1994).
406. "Synthesis of Functional Symmetrical Biaryls from Phenols via Nickel-Catalyzed Coupling of Their Sulfonates" by J. Y. Bae, M. Zhao, **D. H. Hill** and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 138 (1994).
407. "Synthesis of Functional Regioregular and Regioirregular Substituted Poly(*p*-Phenylene)s from Hydroquinones" by **J. Y. Bae**, M. Zhao, D. H. Hill and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 139 (1994).
408. "Similarities and Differences Between the Phase Behavior of LC Polyethers Based on the Constitutional Isomeric 1-(4-Hydroxy-4'-Biphenyl)-2-(4-Hydroxyphenyl)butane and 1-(4-Hydroxyphenyl)-2-(4-Hydroxy-4'-Biphenyl)butane Mesogens" by V. Percec and **A. Asandei**, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 282 (1994).
409. "Molecular Order in the Nematic Melt of a Semiflexible Polyether by Deuteron NMR" by **D. Y. Yoon**, M. H. Sherwood, G. Sigaud, C. G. Wade, M. Kawasumi and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 289 (1994).
410. "Optical Studies of Supramolecular Tubular Structures with Tapered Side Groups in the Hexagonal Phase" J.-F. Li, V. Percec, C. Rosenblatt and M. Fisch, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 294 (1994).
411. "Inversion Wall Evolution in Magnetic Fields in a Thermotropic Liquid Crystalline Polymer" by M. J. O'rourke, **E. L. Thomas** and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 305 (1994).

412. "Structure and Phase Behavior of Thermotropic Main Chain Liquid Crystalline Polyethers" by Y. Yoon, A. Zhang, S. Z. D. Cheng, J. Cheng and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 312 (1994).
413. "Towards 'Willow-like' Thermotropic Liquid Crystalline Dendrimers" by V. Percec and P. Chu, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 332 (1994).
414. "Tobacco Mosaic Virus-like Self-Assembled Supramolecular Architectures" by V. Percec, J. Heck, G. Johansson and G. Ungar, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 347 (1994).
415. "The Supramolecular Tubular Structures of a Poly(methacrylate) with Tapered Side Groups Formed in its Aligned Hexagonal Phases" by J. Blackwell, Y. K. Kwon, S. Chvalun, A. I. Schneider, V. Percec and J. Heck, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 348 (1994).
416. "Molecular Recognition Directed Self-Assembly of Tubular Liquid Crystalline and Crystalline Supramolecular Architectures Derived From Crown Ethers Containing Tapered Groups" by G. Johansson and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 350 (1994).
417. "Molecular Recognition Directed Phase Transitions in Side Chain Liquid Crystalline Polymers Containing Crown Ethers" by G. Johansson and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 351 (1994).
418. "Molecular Recognition Directed Self-Assembly of Tubular Supramolecular Architectures Containing Semifluorinated Tapered Groups" by G. Johansson, D. Schlueter and V. Percec, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 354 (1994).
419. "The Role of Ion-Pair Solvation on the Self-Assembly of Tapered Shaped Groups into Tubular Supramolecular Structures" by V. Percec, J. Heck and G. Ungar, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 357 (1994).
420. "Supramolecular Rigid Rods from Collapsed Macrocyclics" by V. Percec and M. Kawasumi, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 363 (1994).
421. "Cyclic Main-Chain Oligoether Smectics" by G. Ungar, D. Abramic, V. Percec, M. Kawasumi, P. Chu and A. D. Asandei, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 365 (1994).



422. "Synthesis and Characterization of a Liquid Crystalline Macrocyclic Tetramer Based on 1-(4-Hydroxy-4'-Biphenyl)-2-(4-Hydroxyphenyl) Butane and Triethylene Glycol" by **P. Turkaly**, V. Percec, P. L. Rinaldi and V. E. Litman, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 381 (1994).
423. "Gel Template Leaching and Other Concepts to Functional Microporous Membranes and Stable Ionic Channels" by H. Gankema, G. Johansson, V. Percec and **M. Möller**, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 383 (1994).
424. "Semifluorinated Polyethylenes via Radical Addition Chain Transfer of  $\alpha,\omega$ -Diiodoperfluoralkanes with  $\alpha,\omega$ -Dienes. Initiation by Pd(0)[PPH<sub>3</sub>]<sub>4</sub> Versus AIBN" by V. Percec, **D. Schlueter** and M. Zhao, Poster, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 195 (1994).
425. "Biaxiality in a Cyclic Thermotropic Liquid Crystal" by **J. F. Li**, V. Percec, C. Rosenblatt and O. D. Laventovich, Poster, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 417 (1994).
426. "Synthesis of Non-Linear Optical Liquid Crystalline Materials" by **M. Trollsas**, F. Sahlen, H. Andersson and A. Hult, Poster, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 424 (1994).
427. "Side Chain Liquid Crystalline Polymers with Poly(*p*-Phenylene)s as Backbone" by V. Percec, J. Bae and **D. Crawford**, Poster, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 444 (1994).
428. "Thermotropic Cubic, Smectic and Columnar Phases in a Class of Polymers with Hemiphasmidic Side Groups" by G. Ungar, V. Percec and **J. Heck**, Poster, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 458 (1994).
429. "Linear and Macrocyclic Liquid Crystal Polymers" by **G. Ungar**, J. P. Zhou, V. Percec, P. Chu, M. Kawasumi and S. Z. D. Cheng, 35th IUPAC International Symposium on Macromolecules, "MacroAkron '94," The University of Akron, Akron, OH, July 11-15, 1994. *Abstracts*, 808 (1994).
430. "Supramolecular Channels and Rods" by **V. Percec**, Plenary Lecture, Symposium on Recognition Processes, Royal Society of Chemistry, Perkin Division, The University of Birmingham, Birmingham, UK, July 23-29, 1994.
431. "Molecular Engineering of LCPs" by **V. Percec**, "P. Poni" Institute of Macromolecular Chemistry, Iasi, Romania, August 24, 1994.
432. "Molecular Recognition Directed Self-Assembly of Complex Supramolecular Architectures" by **V. Percec**, "P. Poni" Institute of Macromolecular Chemistry, Iasi, Romania, August 25, 1994.

433. "Polymer Chemistry at Its First Turn of the Century. Towards a Reunification of Chemical Sciences?" by **V. Percec**, Romanian Academy, Bucharest, Romania, August 30, 1994.
434. "Supramolecular Liquid Crystalline Polymers" by **V. Percec**, Plenary Lecture, IUPAC International Conference on LC Polymers, Beijing, China, September 6-9, 1994. *Proceedings of ICLCP*, 4 (1994).
435. "Is the Polymer Backbone Involved in the Dielectric Relaxation of a Side-Chain Liquid Crystalline Polymer?" by **Z. Z. Zhong**, D. E. Schuele, W. L. Gordon and **V. Percec**, IUPAC International Conference on LC Polymers, Beijing, China, September 6-9, 1994. *Proceedings of ICLCP*, 152 (1994).
436. "Towards Tobacco Mosaic Virus-like Supramolecular Architectures" by **V. Percec**, Invited Lecture, Polymer Symposium, University of North Carolina at Chapel Hill, Chapel Hill, NC, September 14-15, 1994.
437. "Molecular Order and Dynamics in a Semiflexible Liquid Crystalline Polymer by Deuteron NMR," by M. H. Sherwood, G. Sigaud, D. Y. Yoon, **C. G. Wade**, M. Kawasumi and **V. Percec**, FAC 94 Meeting, St. Louis, Missouri, October 2-7, 1994.
438. "Molecular Design of Liquid Crystalline Polymers with Complex Architecture: Macrocyclics and Dendrimers" by **V. Percec**, Invited Lecture, IUPAC International Symposium on Functional and High Performance Polymers, Taipei, Taiwan, ROC, November 14-16, 1994. *Polymer Preprint*, 291 (1994).
439. "Towards Tobacco Mosaic Virus-like Self Assembled Supramolecular Architectures" by **V. Percec**, Plenary Lecture, Mini-Symposium on Functional Molecules, Institute of Chemistry, Academia Sinica, Taipei, Taiwan, ROC, November 18, 1994.
440. "Nature as Model for the Design of New Macromolecular and Supramolecular Architectures" by **V. Percec**, Mini-Symposium on Polymer Chemistry, Department of Chemistry, National Taiwan University, Taipei, Taiwan, ROC, November 19, 1994.
441. "Self-Assembly of Viruses as Models for the Design of New Macromolecular and Supramolecular Architectures" by **V. Percec**, Tohoku University, Japan, November 21, 1994.
442. "Molecular, Macromolecular and Supramolecular Liquid Crystals with Complex Topologies" by **V. Percec**, Iwate University, Morioka, Japan, November 22, 1994.
443. "Supramolecular Polymers" by **V. Percec**, Asahi Co., Shin-Fuji, Japan, November 24, 1994.
444. "State of the Art and Future Trends in Polymerization Methods" by **V. Percec**, Toray Industries Company, Ltd., Nagoya, Japan, November 25, 1994.
445. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Kao Corp., Wakayama, Japan, November 28, 1994.

446. "Molecular Recognition Directed Self-Assembly of Complex Supramolecular Architectures" by **V. Percec**, Invited Main Lecture, "Challenges in Polymer Science and Technology," 5th SPSJ International Polymer Conference, Osaka, Japan, November 28-December 2, 1994. *Preprints*, p. 20, 1994.
447. "Molecular Recognition Directed Self-Assembly of Supramolecular Architectures" by **V. Percec**, Osaka University, Osaka, Japan, December 2, 1994.
448. "Polymer Industry in the Next Century!?" by **V. Percec**, DSM, Holland, January 10, 1995.
449. "Nature as Model for the Design of New Supramolecular and Macromolecular Architectures" by **V. Percec**, Kimberly-Clark Corporation, Neenah, WI, January 27, 1995.
450. "Self-Assembly of Viruses as Models for the Design of New Macromolecular and Supramolecular Architectures" by **V. Percec**, Invited Lecture, 1995 Marvel Symposium, Tucson, AZ, March 12-13, 1995.
451. "The Supramolecular Tubular Structures Formed by a Polymethacrylate with Highly Tapered Side Groups" by **J. Blackwell**, Y. K. Kwon, C. A. Danko, S. Chvalun, V. Percec and J. A. Heck, Division of High Polymer Physics, APS Meeting, "Liquid Crystalline Polymers," San Jose, CA, March 20-23, 1995.
452. "Neutron Scattering Study of Molecular Order in Nematic Melts of a Semiflexible Polyether" by **D. Y. Yoon**, F. Hardouin, G. Sigaud, M. F. Achard, A. Brulet, J. P. Cotton, M. Kawasumi and V. Percec, Division of High Polymer Physics, APS Meeting, "Neutron Scattering from Polymers I," San Jose, CA, March 20-23, 1995.
453. "X-ray Diffraction Studies of Thermotropic Cubic Phases Formed by Cone-Shaped Molecules" by V. S. K. Balagurusamy, G. Ungar, D. Abramic, V. Percec and J. Heck, 10th Annual Conference, British Liquid Crystal Society, University of Exeter, United Kingdom, March 29-31, 1995.
454. "Calamitic Nematic to Columnar Phase Transition in Main Chain Thermotropic Polyethers" by J. Zhou, G. Ungar, V. Percec, P. Chu and S. Z. D. Cheng, 10th Annual Conference, British Liquid Crystal Society, University of Exeter, United Kingdom, March 29-31, 1995.
455. "Liquid Crystalline Cyclic Main Chain Oligomers" by G. Ungar, J. Zhou, D. Abramic, V. Percec, M. Kawasumi and P. Chu, 10th Annual Conference, British Liquid Crystal Society, University of Exeter, United Kingdom, March 29-31, 1995.
456. "Self-Assembly of Viruses as Models for the Design of New Macromolecular and Supramolecular Architectures" by **V. Percec**, Invited Lecture, ACS Meeting, "Synthesis of Well-Defined Macromolecules for Assembly and Function - Novel Architectures," Anaheim, CA, April 2-7, 1995. *Polymer Preprint*, 591 (1995).
457. "Willow-like Hyperbranched and Dendrimeric Liquid Crystals" by **V. Percec** and P. Chu, ACS Meeting, "Recent Advances in Step-Growth Polymerization -

- Dendritic and Hyperbranched Systems," Invited Lecture, Anaheim, CA, April 2-7, 1995. *Polymer Preprint*, 743 (1995).
458. "Regioregular and Regioirregular Substituted Poly(p-phenylene)s by Ni(0) Catalyzed Dimerization and Polymerization of Arylmesylates and Arylenebismesylates" by V. Percec, J.-Y. Bae, M. Zhao and D. H. Hill, Invited Lecture, ACS Meeting, "Recent Advances in Step-Growth Polymerization - Transition-Metal-Catalyzed Polymerizations," Anaheim, CA, April 2-7, 1995. *Polymer Preprint*, 699 (1995).
  459. "Nature as Model for New Supramolecular Liquid Crystals" by V. Percec, Plenary Lecture, International Symposium, "Ordered Fluids and Liquid Crystals - New Materials," Div. Coll. Surface Sci., ACS, Anaheim, CA, April 2-7, 1995.
  460. "Effect of Temperature on the Supramolecular Tubular Structure in Oriented Fibers of a Poly(methacrylate) with Tapered Side Groups" by J. Blackwell, Y. K. Kwon, S. Chvalun, V. Percec and J. A. Heck, Invited Lecture, ACS Meeting, "Processing-Structure-Property Relationships in Liquid Crystalline Polymers," Anaheim, CA, April 2-7, 1995. *Polym. Mat. Sci. Eng.*, 72, 427(1995).
  461. "Structure and Phase Behavior of Thermotropic Main-Chain Liquid Crystalline Polyethers" by Y. Yoon, S. Z. D. Cheng, P. Chu and V. Percec, Invited Lecture, ACS Meeting, "Processing-Structure-Property Relationships in Liquid Crystalline Polymers," Anaheim, CA, April 2-7, 1995. *Polym. Mat. Sci. Eng.*, 72, 433(1995).
  462. "Supramolecular Rods from Collapsed Macrocyclics" by V. Percec, M. Kawasumi and G. Ungar, Invited Lecture, ACS Meeting, "Symposium for K. Matyjaszewski to Receive the C. S. Marvel Award for Creative Polymer Chemistry," Anaheim, CA, April 2-7, 1995. *Polymer Preprint*, 527 (1995).
  463. "Heterochiral Recognition in Molecular and Macromolecular Pairs of Liquid Crystal Enantiomers and Diastereomers" by V. Percec and H. Oda, Invited Lecture, ACS Meeting, "ACS Award in Applied Polymer Science Symposium in Honor of J. P. Kennedy," Anaheim, CA, April 2-7, 1995. *Polym. Mat. Sci. Eng.*, 72, 229(1995).
  464. "Self-Assembly of Viruses as Model for the Design of New Supramolecular and Macromolecular Molecular Architectures" by V. Percec, Invited Lecture, "International Symposium on Macromolecular Architecture. Nature as a Model for the Molecular Design of the Polymeric Materials of Tomorrow", Stockholm, Sweden, April 20-21, 1995.
  465. "Synthesis of Non-Linear Optical Liquid Crystalline Materials" by M. Trollsås, F. Sahlen, H. Andersson, U.-W. Gedde, A. Hult and V. Percec, , "International Symposium on Macromolecular Architecture. Nature as a Model for the Molecular Design of the Polymeric Materials of Tomorrow", Stockholm, Sweden, April 20-21, 1995.
  466. "Nature as Model for the Design of Supramolecular and Macromolecular Architectures" by V. Percec, Invited Lecture, Bayreuth Polymer and Materials Research Symposium, Bayreuth, Germany, April 24-26, 1995.
  467. "Liquid Crystals with Complex Architecture" by V. Percec, Albert-Ludwigs-University-Freiburg, Freiburg, Germany, April 26, 1995.

468. "From Quasi Rigid Supramolecules to Rigid Rod-Like Macromolecules," by V. Percec, Invited Lecture, Polymer Minisymposium, Carnegie Mellon University, Pittsburgh, PA, May 6, 1995.
469. "Is Any Molecular, Macromolecular or Supramolecular Architecture Which Should Not Display Liquid Crystallinity?" by V. Percec, Invited Lecture, ONR Polymer Program, Leesburg, VA, May 8-11, 1995.
470. "Towards Tobacco Mosaic Virus-like Self Assembled Supramolecular Structures" by V. Percec, Plenary Lecture, International Conference, Nano-Structures and Self Assemblies in Polymer Systems, Cruise from St. Petersburg to Moscow, Russia, May 21-28, 1995.
471. "Phase Identifications in a series of liquid crystalline TPP polyethers and copolyethers having highly ordered mesophase structures" by S. Z. D. Cheng, Y. Yoon, A. Zhang, V. Percec and P. Chu, Invited Lecture, ACS 27th Central Regional Meeting, Akron, May 31-June 2, 1995
472. "Viruses as Models for the Engineering of New Molecular and Supramolecular Architectures" by V. Percec, Invited Lecture, Polymers for Advanced Technologies, PAT '95, Pisa, Italy, June 11-15, 1995.
473. "Nature as Model for the Design of New Supramolecular and Macromolecular Architectures" by V. Percec, Invited Lecture, "Frontiers in Polymer Chemistry - Symposium in Honor of Professor C. I. Simionescu's 75th Birthday," Jassy, Romania, June 19-20, 1995.
474. "Macromolecular and Supramolecular Rods" by V. Percec, Invited Lecture, 1995 Gordon Research Conference on Polymers, Henniker, NH, June 25-30, 1995.
475. "Cubic, Columnar and Smectic Polymer-Ion Complexes, by G. Ungar and V. Percec, Contributed Lecture, IUPAC International Symposium on Polymer Morphology and Electrical Properties, July 5-7, 1995, Lodz, Poland, *Abstracts* . p 5.
476. "Cyclic Main Chain Oligoether Smectics", by G. Ungar, D. Abramic, V. Percec and M. Kawasumi, IUPAC International Symposium on Polymer Morphology and Electrical Properties, July 5-7, 1995, Lodz, Poland, *Abstracts* , p 13.
477. "Rod-Like Columnar-Nematic Phase Sequence in Main-Chain Thermotropic Copolymers", IUPAC International Symposium on Polymer Morphology and Electrical Properties, July 5-7, 1995, Lodz, Poland, *Abstracts* , p. 14.
478. "Viruses as Model for the Design of New Macromolecular and Supramolecular Architectures" by V. Percec, Invited Lecture, 1995 Gordon Research Conference on Chemistry of Supramolecules and Assemblies, Henniker, NH, July 23-28, 1995.
479. "Molecular and Supramolecular Liquid Crystalline Dendrimers" by V. Percec and P. Chu, Invited Lecture, ACS Meeting, Symposium on Dendrimers and Hyperbranched Polymers, Chicago, IL, August 20-25, 1995. *Polym. Sci. Eng.* 73, 125 (1996).

480. "Ni(0)-Catalyzed Homocoupling and Cross-Coupling Reactions of Arylmesylates and Their Application to Synthesis of New Polymers" by V. Percec, J.-Y. Bae, M. Zhao and D. H. Hill, Invited Lecture, ACS Meeting, "Polymer Synthesis with Organometallic Catalysts," Chicago, IL, August 20-25, 1995. *Polym. Sci. Eng.* **73**, 510 (1996).
481. "Supramolecular Architectures via Molecular Recognition and Ionic Polymerization Processes," by V. Percec, Invited Lecture, IUPAC Symposium on Ionic Polymerization, Istanbul, Turkey, September 4-8, 1995.
482. "Complex Molecular and Supramolecular Topologies", by V. Percec, Invited Lecture, NATO Advanced Research Workshop on Modular Chemistry, Estes Park, CO, September 9-12, 1995.

#### **j. Honors/ Awards/ Prizes**

1990 and 1995: NSF Research Award for Exceptional Creativity in Research (V. Percec)  
 1993 Elected Honorary Foreign Member to the Romanian Academy (V. Percec)  
 1993 Leonard Case Jr. Professor of Macromolecular Science and Engineering (V. Percec)  
 Elected Member of the Editorial Board of 8 International Journals

#### **k. Total number of Graduate Students (10) and Postdoctoral associates (2)supported**

1. Coleen Pugh (PhD) Assistant Professor University of Michigan Ann Arbor
2. C. Hsu (PhD) Professor Hsinchu University, Taiwan
3. Caroline Ackermann (MS) industry
4. J. Zheng (PhD) Stanford Research Institute
5. D. Tomazos (PhD) Deceased
6. M. Lee (PhD) Professor Yosheva University, Korea
7. A.S. Gomes (post doc) Professor and Director E. Mano Institute of Macromolecules, University of Rio de Janeiro, Brasil
8. G. Johansson (PhD) IBM
9. H. Jonsson (post doc) BAYER
10. D. Crawford (Msc) industry
11. L. Lemon (Msc) industry
12. Beatrice Lin (MSc) Graduate student, University of Chicago

#### **Significant Results Obtained During this Period**

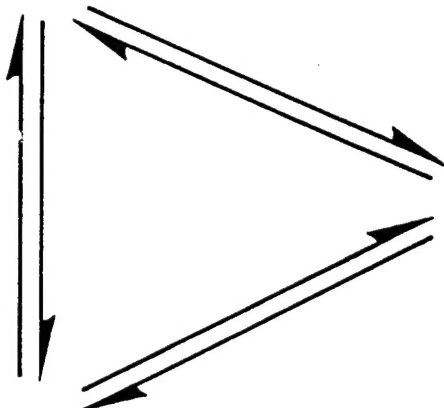
This research produced the first quantitative approach to the elucidation of the structure-properties relationship in the field of side chain liquid crystalline polymers via a molecular engineering approach. The elucidation of the mechanisms required for the formation of nematic, smectic, various chiral smectic, reentrant nematic and other phases in conventional end-on and in side-on side chain liquid crystalline polymers was approached via a combination of living polymerization reactions for the first time. This approach generated the first : molecular understanding-molecular engineering-technological applications concept from this field (see attached Scheme 1). The knowledges generated from this program were applied to the field of functional liquid crystalline polymers.

The results of this research were published in 74 refereed publication, reviewed in 11 book chapter published by invitation and 285 invited lectures.



# SIDE CHAIN LIQUID CRYSTALLINE POLYMERS

**MOLECULAR UNDERSTANDING**



**MOLECULAR ENGINEERING**

**APPLICATIONS**

- ANISOTROPIC GLASSES
- SELECTIVE WAVELENGTH DETECTORS
- POLARIZABLE FILTERS
- LARGE LC DISPLAYS
- INFORMATION STORAGE
- FERROELECTRIC MATERIALS
- PIEZOELECTRIC ELASTOMERS
- NON-LINEAR OPTICS
- INTEGRATED OPTICS
- DETECTORS & SENSORS
- SUPER-IONIC CONDUCTORS
- CHROMATOGRAPHIC STATIONARY PHASES
- PHOTOCHROMIC & PHOTO-CONDUCTIVE POLYMERS
- SUPERBARRIERS
- HIGH PERMEABILITY & SELECTIVITY MEMBRANES
- CONTROLLED DRUG RELEASE
- EXTERNALLY REGULATED SYSTEMS

SCHEME 1